OBSERVATIONS OF BODY INJURIES OF ARTIFICIALLY INSEMINATED HONEYBEE QUEENS INFLICTED IN THE SUBSEQUENT STAGES OF REARING AND DURING THEIR INTRODUCTION INTO COLONIES

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S u m m a r y

This paper analyses the production technology (rearing) of artificially inseminated honeybee queens in case of occurance of body injuries and queen losses as well as determination of the effect of body mass and rearing period of the queens on bee susceptibility to their injuries. Observations were made on 7272 queens, by controlling their condition four times under a microscope, from the emergence from a queen-cell to introduction into a bee colony, after each contact of queens with bees unfamiliar to them. The observations were carried out in 4 stages on a different number of the queens: stage I was from leaving a queen-cell to queen insemination, stage II from insemination to the second CO_2 narcosis, stage III from the second CO_2 narcosis till the queens' introduction into nucleuses, and stage IV from the introduction till the acceptance of the queens in bee colonies.

Injured queens (n=579) were divided into groups with similar injuries, i.e. queens with injuries of arolium and claws (44.2% of total injured), queens with paralyzed legs (18.8%), and queens with missing parts of legs (32.0%). Sporadically, queens with injured antennae and those with injured wings were observed, i.e. 2.9% and 2.1% of injured queens, respectively.

The frequency of injuries of the queens, as well as their mortality rate increased in the subsequent stages of production. The lowest number of injured queens was reported in stages I and II (2.0% and 4.0%, respectively), slightly higher in stage III – 13.0%, whereas the highest one (32.7%) was in the last, stage IV.

In the case of queens reared in the period from May till July, the frequency of injuries was similar in each month. Their mortality rate was at a similar level as well.

The term of queen introduction into colonies had no significant effect on the percentage of injured queens during their acceptance. The worst results of queen introduction were obtained in June (29.4% of unaccepted queens), whereas in the other months, the percentage of unaccepted queens ranged from 6.7% to 8.9% of the queens.

Some of the queens (n=2784) were weighed before insemination in order to determine the relationship between their body mass and the possibility of their injury. It turned out that body mass did not affect either the susceptibility of bees to injuries or their mortality rate.

Keywords: honeybee queen, injuries of queens, insemination, body mass of queens, queen rearing, queen introduction.

INTRODUCTION

Injuries of honeybee bodies are likely to occur during incompetent work of beekeepers and breeders at their rearing. They include mechanical injuries of queen legs, indentantion of thorax, and injury to reproductive organs of the queens during their artificial insemination. The most nu-

merous however, yet often unnoticed, are those inflicted by bees attending the queens and nursing them during the production process (Woyke et al. 1956, Woyke 1988, Jasiński 1987, 1995, Jasiński and Fliszkiewicz 1995, 1996, Loc et al., 1996, Wilde and Loc 1997), as well as by bees of colonies the queens are introduced into (Gerula 2004). Usually, those injuries ocurred at the moment of the first contact of queens with unfamiliar bees. In both cases, bees injure most often the legs of the queens and, to a lesser degree, their antennae and wings.

The problem of queen injuries refers in particular to artificially inseminated queens, less frequently to those naturally mated (Gerula and Bieńkowska 2002). This is linked with the length and complexity of the production period which includes rearing the queens, a period before insemination, insemination and post-insemination nursing; in subsequent stages – depending on the adopted technology – the introduction of the queens into nucleuses or bee colonies.

Losses of queens, regardless of the cause, are more severe when recorded amongst older queens that had required greater work input. In observing losses of queens from their emergence till the onset of oviposition in nucleuses, Moritz and Kühnert (1984) noted that the highest mortality rate occurred in the period from queen introduction into nucleuses till the first CO_2 narcosis in the 5^{th} day of life (47% of all losses). Then from the first narcosis and insemination on day 7 of life they reported 11%, whereas between insemination and the onset of oviposition there was a 35% mortality rate of the queens. Losses reaching 7% were observed even after starting egg laying.

In honeybee queen rearing, a critical moment is their introduction into colonies. The efficiency of introduction is determined by a variety of factors. Butler and Simpson (1956) noted the variability in queen acceptance depending on the term of introduction. In their study, the worst results were obtained in July. No significant differences were observed in queen acceptance with the application of various types of cages (Butler and Simpson 1956, Marcinkowski 1982, Skubida and Pohorecka 2000, Christov 2003). Neither it did matter whether attendant bees were present in the cages or not (Christov 2003).

Medina and Goncalves (2001) claim that queens of Africanized bees with an average mass of 180-200 mg are slightly better accepted and their mating flights are succesfull in a higher rate than for the lighter and heavier ones. In turn, Taranov (1973) reports that the heaviest queens perform mating flight earlier and that they also start egg laying earlier. It remains unknown, however, whether bees demonstrate the same behavior towards queens with various body mass.

The aim of the study was to analyze injuries of artificially inseminated queens since the emergence from a queen-cell till their acceptance in bee colonies as affected by the season of the rearing period of queens, the date of their introduction into colonies and their mass.

MATERIAL AND METHODS

Observations were carried out in the years 2001-2005 in Pulawy, in an apiary of the Labolatory of Honeybee Breeding and Bee Biology, Apiculture Division, Research Institute of Pomology and Floriculture in Skierniewice. The experimental material was made of honeybee queens belonged to two races: caucasian race – Pulawska line and carniolan race – Marynka, Zosia and GR1 lines.

Preparation of experimental material

The queens' rearing was carried out in queenless colonies with the method of lar-

vae grafting. Capped queen-cells were isolated to "Zander" type cages and transfered into incubator. Immediately after the queens' emergence, they were observed under a stereoscope microscope at 30x magnification to detect their malformations and any other body injuries. Such queens were eliminated. The emerged virgin queens were marked and put into the mailing cages with bees from a queenless colony (n=25-30). Then, they were kept in a laboratory at room temperature until artificial insemination.

Immediately before insemination, some of the queens were weighed on a MEDICAT electronic scale precise to 1 mg in order to determine the relationship between their body mass and likelihood of their injuries. The queens were inseminated when 6-8 days old with a single dose of 8 µl of semen and under 3-minute CO_2 narcosis. After insemination, the queens which had awoken from narcosis were put into the cages with new bees coming from a queenless colony and incubated for 48-96 hours at a temperature of 30ºC and humidity of 80%.

Afterwards, the queens were subjected to the second 3-minute CO_2 narcosis and put into new mailing cages without attendant bees and introduced into nucleuses for onset of oviposition. The nucleuses were prepaired in 3-frame maiting hives made of styrofoam and colonized with ca. 1000 bees. Entrances of the hives were provided with a queen excluder to prevent mating flights of the queens.

Egg laing queens from the nucleuses were then put into mailing cages and introduced into colonies established in Dadant hives. During the five years experiment, a total of 7272 honeybee queens were reared, of which 7025 were artificially inseminated. A number of 602 from inseminated queens were introduced into nucleuses, whereas 330 queens were introduced into bee colonies.

Scheme of the experiment – stages of queens' rearing

Observations of injuries to the bodies of artificially inseminated honeybee queens and monitoring their mortality rate during their rearing period following emergence from a queen-cell to acceptance in a bee colony were run in 4 stages:

— I stage: from emergence from a queen-cell till insemination of a queen
— II stage: from insemination till the second CO_2 narcosis
— III stage: from the second CO_2 narcosis till the queens' acceptance in nucleuses
— IV stage: from introduction till acceptance of the queens in bee colonies.

The criterion of division into stages was the frequency of the queens' contact with new, unfamiliar bees that were likely to injure them. The queens had contact with new bees four times, i.e. twice in the two first stages in cages with a low number of bees, and in subsequent stages with a higher number of bees in mating colonies and bee colonies. The onset of a stage was determined by the first contact of queens with bees and the end by queens' separation from the bees; whereas in the case of stage IV it was determined by the confirmation of their presence in the colony during hive inspection.

On commencement of each experimental stage, before queen introduction to new bees, the queens were observed under a stereoscope microscope to detect body injuries.

Groups of queen injuries

The basic value characterizing the phenomenon of injuries was the number of injured queens. Results of observations of damaged queens were expressed in their percentage in the total number of the observed queens or in the percentage of queens with various injuries in the total number of injured queens.

According to the type of injury, the in-

jured queens were divided into five groups. Particular groups included queens with similar injuries relating to the same part of the body. The groups were ordered according to ascending harmfulness of injuries to the functioning of queens. Apart from non-injured queens, injured ones were grupped as:

1.Inuries of Arolium and Claws (IAC)
2.Paalysis of Legs (PL)
3.Missing Parts of Legs (MPL)
4. Inuries of Antennae (IA)
5. Inuries of Wings (IW)

The basis of injury harmfulness classification was the extent to which they impair a queen's capacity for intensive egg laying and inclination of bees to supersedure, which was determined in previous studies (Gerula and Bieńkowska 2002, Gerula 2004). Upon classification of the queens to particular groups, only those newly-injured were taken into consideration.

Statistical analyses

ANOVA was used for comparison of the number of injured queens, their mortality rate and the number of unaccepted queens in particular stages of the production process and months of their introduction. The percentages for statistical calculations were transformed according to the Bliss function. Homogenous groups were discriminated with a Duncan's test at a significance level of α=0.05.

RESULTS

Description of queen injuries

During all experimental years and each of rearing stages, a total of 579 injured queens were observed. There were 17 types of body injuries noted for the queens inflicted by atendant bees in cages before and after insemination, as well as by those from nucleuses and bee colonies. Of all the injured queens, the most numerous group constituted those with injuries of arolium and claws (IAC) – 44.2% and those with missing parts of legs (MPL) – 32.0%. The group of queens with paralyzed legs was slightly less numerous (PL) and it accounted for 18.8%. Injuries of antennae (IA) and wings (IW) were sporadic, i.e. 2.9 and 2.1%, respectively. Amongst the injured queens, the highest number had injured legs (n=550, groups: IAC, PL, MPL), which accounted for 95.0% of all injured queens. A detailed description of injuries, number and percentage of injured queens from particular groups is presented in Table 1.

Frequency of injuries of honeybee queen legs caused by bees

In total of 550 queens with leg injuries, there prevailed those with injuries of one leg (83.6%), regardless of the type of injury. A considerably smaller percentage was reported for those with 2 damaged legs (7.8%). In turn, the lowest number of queens with 3 or more injured legs was noted. Such queens were observed sporadically, most often in the IAC group amongst queens with injured arolium and claws.

The most frequently, the queens with injuries of one pair of legs, considerably less frequently of two or three pairs simultaneously were observed, besides bees causing damage to the queens had no distinct preferences for damaging some particular pair of legs. Damage to at least one leg of the first pair was recorded 27.6% of the queens, those of the second pair – in 28.3% of the queens, and damage to the legs of the third pair – 29.6% of the queens. Injuries to one or two legs of the first and second pair, the first, second and third pair or the first and third as well as the second and third pair occurred remarkably less frequently, i.e. in 1.3 and 6.9% of the queens.

Table 1

Type of injuries and percentage of injured queens classified by particular experimental groups. Years 2001-2005, all stages of rearing

Group of injuries	Number of injured queens	Percent of injured queens	Type of queen injuries	Number of injured queens	% of injured queens in particular groups
IAC	256	44.2	Queens with dark arolium	66	25.8
			Queens with black arolium	174	68.0
			Queens with missing arolium	3	1.2
			Queens with missing claws	13	5.0
PL	109	18.8	Queens with paralyzed legs	109	100.0
MPL	185	32.0	Queens with missing 1 tarsus segment	4	2.1
			Queens with missing 2 tarsus segments	39	21.1
			Queens with missing 3 tarsus segments	41	22.2
			Queens with missing 4 tarsus segments	17	9.2
			Queens with missing tarsus	76	41.1
			Queens with missing tibia and tarsus	8	4.3
IA	17	2.9	Queens without 3 antennae segments	4	23.5
			Queens without 4 antennae segments	3	17.6
			Queens without one antennae	8	47.1
			Queens with one paralyzed antennae	2	11.8
IW	12	2.1	Queens without wings	1	8.3
			Queens with mutilated wings	11	91.7
Total injuries	579	100.0			

Table 2

Number and percentage of injured queens from particular groups in all rearing stages. Years 2001-2005.

Rearing stages	Number of observed queens	Number and percentage of injured queens					
		Total of injured	group IAC	group PL	group MPL	group IA	group IW
		no. (%)	no. (%)	no. (%)	no. (%)	no. (%)	no. (%)
I. (before insemination)	7109*	147* (2.0) a	63 (0.9) a	25 (0.3) a	52 (0.7) a	4 (0.06) a	3 (0.04) a
II. (after insemination)	6724	275 (4.0) a	101 (1.5) a	55 (0.8) a	05 (1.5) a	10 (0.15) a	4 (0.05) a
III. (in nuclеuses)	553	72 (13.0) b	32 (5.8) a	18 (3.4) b	16 (2.7) a	1 (0.2) a	5 (0.9) a
IV. (in bee colonies)	260**	85** (32.7) c	60 (23.0) b	11 (4.2) b	12 (4.6) a	2 (0.7) a	0 (0) a
Total		579	256	109	185	17	12

* 59 queens with sting or sting chamber defect culled before insemination were excluded
** 30 queens injured before introduction but accepted in bee colonies were excluded
Different letters in columns next to percentage values- significant differences (at $p \leq 0.05$), percentage were transformed according to the Bliss function.

Injuries to queens in subsequent stages of rearing

The percentage of injured queens was observed to increase along with the subsequent stages of rearing (Table 2).

In the I and II stage, during keeping the queens in cages in an incubator, this percentage was low and accounted for 2 and 4%, respectively. At stages III and IV, it was increasing in a geometrical progression ca. three times in respect of the preceding stage (to 13 and 32.7%), which was confirmed statistically. Significant were also the differences between the percentage of queens classified to groups IAC and PL and injured at different stages of the production process.

Losses of queens in rearing period

Total losses of queens included queens eliminated (culled) at each rearing stage from groups PL, MPL, IA and IW, queens unaccepted by bees, and those that died of other reasons. At stage IV (introduction of queens into colonies), losses also included queens accepted by bees and suitable for culling, yet for various reasons not eliminated from the colonies. The percentage of both culled and dead queens was lower in the two initial stages of rearing when the queens were kept with a low number of attendant bees in cages before and after insemination (Table 3). It indicates a tangible relationship between injuries to the queens and their losses, manifested in the intensifi-

Table 3

Losses of queens in the subsequent rearing stages. Years 20012005.

Rearing stages	Number of queens		Losses of queens in particular production stages		
	At the beginning of stage	At the end of stage	Culled	Dead	Total
			no. (%)	no. (%)	no. (%)
I. (before insemination)	7213*	7025	84 (1.2) a	104 (1.4) a	188 (2.6) a
II. (after insemination)	7025	6550	174 (2.4) a	301 (4.3) a	475 (6.7) a
III. (in nucleuses)	602	513	40 (6.6) b	49 (8.2) b	89 (14.8) b
IV. (in bee colonies)	330	265	25 (7.6) b	40 (12.1) b	65 (19.7) b
Total losses	-	-	323	494	817

* 59 queens with sting or sting chamber defect culled before insemination were excluded
Different letters in columns next to percentage values- significant differences (at $p \leq 0.05$), percentage were transformed according to the Bliss function.

cation of both phenomena in the subsequent stages of rearing.

Effect of the period of queens rearing on inclination of bees to their damage

Neither significant differences between the percentage of queens injured in May, June and July (Table 4), nor losses of queens in those months were observed in all production stages (Table 5), though both the percentage of injured and lost queens and losses were smaller in July at stage I and II, i.e. amongst the youngest queens kept in cages before insemination and those slightly older – after insemination. Different observations were made at stage III, when older queens were introduced into nucleuses. Losses of queens in June and July were greater as compared with May, still they were statistically insignificant.

Effect of the period of queens introduction into colonies on their injuries and losses

In the analysis of injuries and acceptance of the queens by bees in colonies of greater significance is the period of introduction than the date of emergence of the queens. The queens were introduced from the beginning of June till the end of September (Table 6). The percentage of injured queens was not statistically different in particular months of introduction. However, data presented in the table clearly indicate that the percentage of injured queens was substantially higher in July and August than in June and September.

Different results were obtained for the

Table 4

Effect of the period of queens rearing on bee inclination to their imjuries at experimental stages I, II and III. Years 2001-2005.

Period of queens' emergence	Number of queens in particular stages					
	I (in cages before insemination)		II (in cages after insemination)		III (introduction into nucleuses)	
	Observed no	Injured no (%)	Observed no.	Injured no. (%)	Observed no.	Injured no. (%)
May	1194	35 (2.9) a	1117	49 (4.4) a	52	6 (11.6) a
June	4302	99 (2.3) a	4029	182 (4.5) a	290	37 (12.7) a
July	1613	13 (0.8) a	1578	44 (2.8) a	211	29 (13.8) a
Total	7109	147 (2.0)	6724	275 (4.0)	553	72 (13.0)

Different letters in columns next to percentage values- significant differences (at $p \leq 0.05$), percentage were transformed according to the Bliss function.

Table 5

Effect of rearing period of queens on their losses at experimental stages I, II and III. Years 2001-2005.

Period of queens' emergence	Number of queens in particular stages					
	I (in cages before insemination)		II (in cages after insemination)		III (introduction into nucleuses)	
	Observed no	Culled and dead no (%)	Observed no.	Culled and dead no. (%)	Observed no	Culled and dead no. (%)
May	1214	46 (3.8) a	1168	78 (6.6) a	53	3 (5.6) a
June	4377	121 (2.7) a	4256	342 (8.0) a	307	38 (12.4) a
July	1622	21 (1.3) a	1601	55 (3.4) a	242	48 (19.8) a
Total	7213	188 (2.6)	7025	475 (6.0)	602	89 (14.7)

Different letters in columns next to percentage values- significant differences (at $p \leq 0.05$), percentage were transformed according to the Bliss function.

percentage of queens unaccepted by bees in colonies (Table 6). In June, the bees did not accept up to 29.4% of the queens, and that percentage was higher compared with the other months. In July, August and September, the percentage of unaccepted queens was observed to differ, ranging from 6.7 to 8.9%, yet the differences were not confirmed statistically. In June, the queens appeared to be accepted by the bees in colonies to the worst extent, but amongst the accepted queens there was the lowest num-

Table 6

Effect of the period of queens introduction into colonies on their injuries and losses. Years 2001-2005.

Period of queen introduction	Number of introduced queens	Injured queens	Unaccepted queens
		no. (% in relation to accepted queens)	no. (%)
June	68	7 (17.5) a	20 (29.4) a
July	149	52 (39.0) a	10 (6.7) a
August	67	17 (31.4) a	6 (8.9) a
September	46	9 (27.3) a	4 (8.7) a
Total	330	85 (32.7)	40 (12.1)

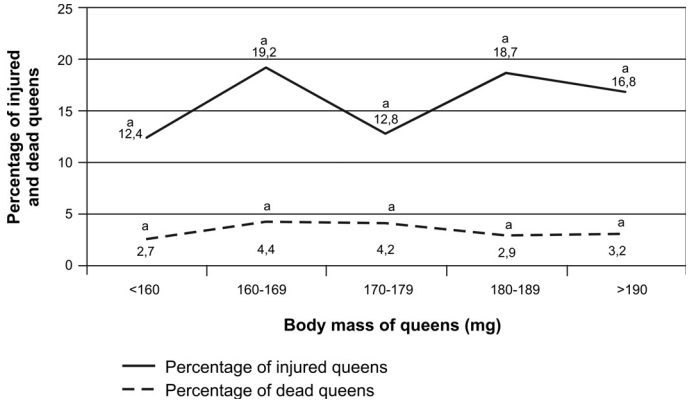

Figure 1. Effect of body mass of queens (n=2784) on their damage and losses at all stages of rearing. Years 2001-2004.

ber of damaged ones. It may be supposed that in this month, the aggression of bees ended mainly with fighting the queens.

Effect of body mass of queens on bee inclination to their damage and their losses

In the years 2001-2004, a total of 2784 queens were weighed. The mass of the queens before insemination varied in wide ranges (Fig. 1). They were grouped in 5 mass intervals. In groups of queens with various mass, the percentage of injured and dead ones was similar and did not differ significantly. Thus, the mass of queens appeared not to exert any effect on their different treatment by bees.

DISCUSSION

It was observed that the injuries of queens inflicted by attendant bees occurred not only during their keeping in queen banks, as reported by Woyke et al. (1956), Woyke (1988), Jasiński (1995), Jasiński and Fliszkiewicz (1995), Loc et al. (1996) as well as Wilde and Loc (1997), but also during their keeping in cages with bees and during their introduction into colonies.

In the reported study, over the entire production period, injuries to legs of queens were slightly different as compared to those observed in queen banks (Jasiński 1995).

A lower percentage was reported for queens with changes of arolium pigmentation and missing arolia or claws, i.e. 41.4 and 2.7%, respectively, in respect to queen banks – 64.0 and 21.0%, respectively. In contrast, in the presented research there were more queens with missing parts of legs (32.0%) than in the banks (15%) and, additionally, a group of queens with paralyzed legs (18.8%). Prevalence in injury to legs in comparison to other organs was also confirmed by Jasiński (1995) who investigated the injuries of queens in queen banks, wherein as much as 99.2% of injuries referred to legs and as little as 0.13% to wings and 0.78% to antennae.

Irrespective of the type of injuries, most of the queens had only one injured leg (83.6%). Similar observations were made by Wilde and Loc (1997) who demonstrated the percentage of queens with only one injured leg at a level of 88.7%.

The frequency of injuries to particular pairs of legs was slightly different than that reported by Wilde and Loc (1997). They observed more frequent injuries to legs of the third and first pair while keeping the queens in queen banks for 48 hours after insemination. In the reported experiment, while summing the entire, much longer nursing period of the queens, it was demonstrated that the frequency of injuries of all pairs of legs was similar.

The percentage of queens injured during keeping in cages in an incubator for the period of ca. 7 days, until insemination (stage I), was substantially lower (2%) than that of queens kept in analogous period in queen banks. In research by Woyke et al. (1956) it ranged from 33.3 to 93.3% depending on the type of cages used, whereas in a study of Jasiński (1995) it accounted for 60.1%. In the current study, 4% of queens were injured during their keeping in cages with bees for 2 days after insemination (stage II). In an analogous period, in queen banks, Loc et al. (1996) found from 2 to 31% of injured queens depending on the method of establishing the nursing colony. In addition, the percentage of dead queens (1.4%) during their keeping in an incubator until insemination was considerably lower than that reported in queen banks (10.2%) by Jasiński (1995) or in mating colonies (14.4%) by Moritz and Kühnert (1984).

The study demonstrated a high increase in the percentage of damaged queens introduced into nucleuses and bee colonies (stage III and IV – Table 2) as compared to the earlier stages (I and II). Especially high was the percentage of injured older, egg laying, queens introduced into colonies at stage IV (32.7%). A similar increase was observed in the percentage of culled and dead queens (Table 3). It might be supposed that these could have been linked with the age of queens which at the stage I and II were 1-10 days old, at the stage III were 11-21 days old, whereas at stage IV were aged for 22-40 days. According to Szabo (1974) and Yadava and Smith (1971), older and egg laying queens are more attractive to worker bees than the young ones, which is reflected in a higher number of bees interested in a queen. It is assumed, thus, that the more attractive queens should be easier accepted in colonies. Hence, there is a discrepancy between results of other authors and findings presented herein. It is likely, however, that the higher attractiveness of queens to bees is not always positive.

In the reported research, the percentage of unaccepted queens was the highest in June. Perhaps the high number of brood in that period unfavoured the acceptance of queens, which was also observed by Szabo (1973). Butler and Simpson (1956) obtained the worst results of queen introduction in July. Such a discrepancy may be explained by differentiated atmospheric and nectar flow conditions at the sites the experiments were carried out in.

CONCLUSIONS

— Injuries to the bodies of honeybee queens caused by worker bees occur throughout the entire period of rearing, including their introduction into mating colonies and bee colonies.
— As compared to keeping the queens in queen banks, in the production technology adopted in the reported study, a lower percentage of queens had injured arolium and claws, whereas a higher percentage was reported for queens with missing parts of legs, injuries of antennae and leg paralysis.
— The percentage of injured queens was observed to increase along with the subsequent stages of rearing, thus also along with the age of queens.
— Losses of queens increased with the subsequent stages of production, hence also with the age of queens.
— During introduction of egg laying queens into colonies, a dependence was observed according to which the queens had the worst acceptance in June, and among the accepted ones there was the lowest number of injured. Thus, aggression of bees towards queens introduced in June was manifested mainly in a lack of their acceptance.
— The body mass of queens had no effect on injuries nor losses of the queens.

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OBSERWACJE POWSTAWANIA USZKODZEŃ CIAŁA MATEK PSZCZELICH SZTUCZNIE UNASIENIONYCH, W KOLEJNYCH ETAPACH WYCHOWU ORAZ W TRAKCIE PODDAWANIA ICH DO RODZIN

Gerula D.

Streszczenie

Obserwacje prowadzono w latach 2001-2005 w Puławach w pasiece Zakładu Biologii i Hodowli Pszczół Oddziału Pszczelnictwa, Instytutu Sadownictwa i Kwiaciarstwa w Skierniewicach. Przedmiotem pracy była analiza technologii produkcji (wychowu) matek pszczelich sztucznie unasienionych w kierunku powstawania uszkodzeń ciała i strat matek, a także określenie wpływu masy i terminu wychowu matek na skłonność pszczół do ich uszkadzania. Przed inseminacją matki przetrzymywano w klateczkach transportowych z pszczołami towarzyszącymi, podobnie jak i przez pierwsze dwie doby po inseminacji. Następnie poddawano je do rodzinek weselnych w celu rozczerwienia, po czym czerwiące poddano do rodzin. Obserwacji poddano 7272 matki, kontrolując czterokrotnie pod mikroskopem ich stan, od wygryzienia z matecznika do przyjęcia w rodzinie pszczelej, po każdym kontakcie matek z nowymi dla nich pszczołami. Obserwacje te wykonywano w 4 etapach na różnej liczbie matek: I etap od wyjścia z matecznika do inseminacji matki, II etap od inseminacji do drugiej narkozy CO2, III etap od drugiej narkozy CO_2 do przyjęcia matek w rodzinkach weselnych, IV etap od poddania do akceptacji matek w rodzinach pszczelich.

Zaobserwowano 17 różnych rodzajów uszkodzeń ciała 579 matek. Uszkodzone matki podzielono na grupy z podobnymi uszkodzeniami. Wyróżniono następujące grupy: z uszkodzeniami przylg i pazurków (44,2% uszkodzonych matek), ze sparaliżowanymi nogami (18,8%), z ubytkami części nóg (32,0%). Sporadycznie spotykano matki z uszkodzonymi czułkami i skrzydłami w ilości odpowiednio 2,9 i 2,1% matek uszkodzonych. Tak więc uszkodzenie nóg u 550 matek stanowiło 95.0% wszystkich uszkodzeń

Częstość uszkadzania matek w kolejnych etapach produkcji zwiększała się. Najmniej matek uszkodzonych było podczas dwu pierwszych etapów odpowiednio 2,0 i 4,0%, nieco

więcej w trzecim etapie 13,0%, a największy odsetek matek uszkodzonych (32,7%) zaobserwowano podczas ostatniego, IV etapu (poddawane do rodzin).

Termin poddawania matek nie miał istotnego wpływu na odsetek matek uszkodzonych w czasie ich akceptacji. Natomiast najgorsze wyniki poddawania matek uzyskano w czerwcu (29,4% nieprzyjętych matek). W pozostałych miesiącach nieprzyjętych było od 6,7% do 8,9% matek.

Część matek (2784 sztuk) zważono przed inseminacją dla ustalenia związku masy ciała matek z możliwością ich uszkadzania. Okazało się, że masa ciała nie wpłynęła ani na skłonność pszczół do uszkadzania, ani na straty matek.

Słowa kluczowe: matka pszczela, uszkodzenia matek, inseminacja, masa matek, wychów matek, poddawanie matek